Adolescent Idiopathic Scoliosis

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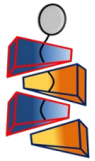
Scoliosis and spinal deformities
Certified Schroth Best Practice Therapist
Certified Schroth ISST Therapist
Certified Basic level BSPTS
Certified SEAS Therapist



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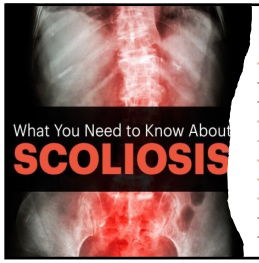

Objectives:-

- Theoretical basis of the Schroth Method
- Definition of scoliosis
- Types of Scoliosis
- Goals of PSSE
- Different Classification systems of Scoliosis
- Pathomechanism of Typical idiopathic Scoliosis
- 3D analysis of Typical Scoliosis
- Basic Radiological Assessment
- Basic management of Scoliosis based on Schroth Classification

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SOSORT

INTERNATIONAL SOCIETY ON SCOLIOSIS ORTHOPAEDIC AND REHABILITATION TREATMENT

Defines PSSE as consisting of:

1. Patient education
2. Auto-correction in 3D
3. Stabilizing the corrected posture
4. Training in activities of daily living (ADL)

European Physical Therapy Schools

Italy	France	Germany/Spain	Poland	England
SEAS	Lyon	Schroth BSPTS-Concept by Rigo	Dobomed FITS	Side Sift

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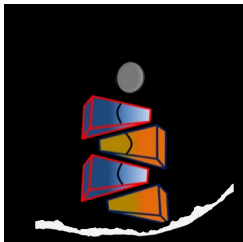

Scoliosis Definition

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Idiopathic Scoliosis :-

- defined as a complex three-dimensional deformity of the spine and trunk, which appears in apparently healthy children, and can progress in relation to multiple factors during any rapid period of growth.
- Specific prevention of idiopathic scoliosis is not possible, because its ultimate cause is unknown; however, there is a high consensus about the necessity to prevent curve progression.
- *In* 1865, Adams also described the presence of lordosis in the thoracic apical region

The most common type of scoliosis is idiopathic scoliosis (IS) which affects about 80-90% of all scoliosis patients.

The classification idiopathic literally means that there is an unknown etiology for the disease. Prevalence 2-6%, need for treatment of about 10% (Weinstein 1985, Konieczny 2013).

The other 10-20% are scoliosis with a known etiology such as congenital, neuropathic, neuro-muscular, or other kinds of systemic diseases.

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Scoliosis Definition

Scoliosis is a series of vertebral segments placed in extension or lordosis, which deflect (deviate), and axially rotate towards the same side.
Idiopathic scoliosis represents the combination of torsional regions joined by junctional zones.
(Doubousset 1992)

Scoliosis is a complex process of **trunk deformation** including **morphological changes** and a **global transformation of the column**, which moves from its **original position** in the **sagittal plane** to a **complex torsional geometry** in the **three dimensions of space**. (Aubin 1998)

Scoliosis is a term used to describe the lateral curvature of the spine. Most cases involve **thoracic** vertebrae, whose **axial rotation** fosters **three-dimensional deformities of the torso.**
(Moe/Nachemson/Lehnert-Schroth)

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The group of idiopathic scoliosis is further divided into three subgroups which are determined by the time that the first scoliotic features are detected:

Infantile Idiopathic Scoliosis (IIS)	age 0 – 3	1%	more boys/thoracic kyphosis
Juvenile Idiopathic Scoliosis (JIS)	age 4 – 9	12-21%	70% requires treatment
Adolescent Idiopathic Scoliosis (AIS)	age >9-17		more girls than boys, thoracic flat back, more typical features

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A new group of more or less idiopathic scoliosis is **adult scoliosis**.

It occurs a long time after skeletal maturity, and stable curvature has been reached and is in a sense the "restart" or renewal of progression, or producing more symptoms, mostly back pain.

The so-called **Adult degenerative scoliosis ADS** (or Adult spinal deformity **ASD**) starts in the

1. **postmenopausal** period accompanied by LBP (low back pain),
2. **LI (laterolisthesis),**
3. **segmental instability,**
4. **central or foraminal spinal stenosis**

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It is likely that most structural spinal deformities start as functional curvatures and only become fixed over time. (Goldberg1978, Riseborough/Herndon1975)

Structural scoliosis is associated with a loss of flexibility in **one or more segments** of the curved spinal column. Vertebrae are fixed in a rotated position, the rib hump is rigid, the normal alignment of the thorax is skewed, and off-center and the discs between vertebrae become compressed or wedged. (Lonstein1995)

Structural curve	a measured spinal curve in the coronal plane in which the Cobb measurement fails to correct past zero on supine maximal voluntary lateral side bending x-ray
Non-structural curve	a measured curve in the coronal plane in which the Cobb measurement corrects past zero on supine lateral side bending x-ray

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Three-dimensional deviation

SOSORT SRS

According to the **SRS (Scoliosis Research Society),** a curve has to have **a Cobb angle of more than 10°.** In children, **rotational aspects should** be taken into consideration even when curves are **below 10° (Scoliometer >4°).**

Scoliosis is a more or less fixed spinal axial deviation depending on the **functional and structural** aspects of the disease followed by typical trunk deformities.

Functional aspects are related to the **postural alteration** and are **reversible during therapy**. This requires an **intensive therapeutic approach to stabilize** the achieved **corrections and recalibrate posture.**

The **structural components** of scoliosis mainly the **mechanical adaptations** of **discs, vertebrae, ribs**
are **not reversible** in **the short terms.**
It **depends** on the **growth potential** whether in the **long terms**

these **structures** can be **reversed** through **the use of braces and specific exercises.**

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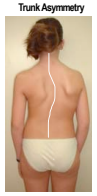
Structural Criteria

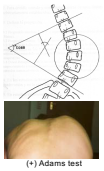
Vertebral Deformity

Lateral deviation with bone deformity (SRS > 10 Cobb)

Trunk Asymmetry



Lateral Deviation with Axial Rotation



(+) Adams test

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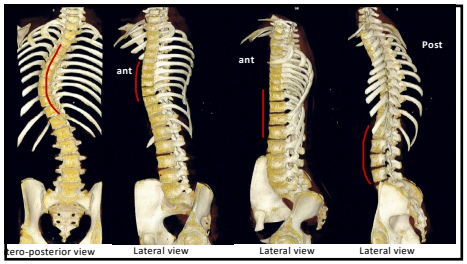

tero-posterior view Lateral view Lateral view Lateral view

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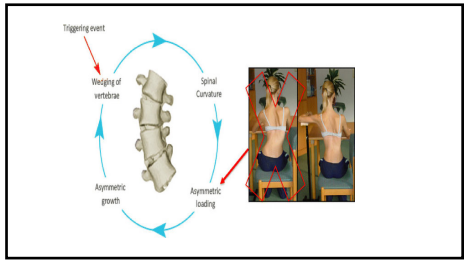
Triggering event
Wedging of vertebrae
Spinal Curvature
Asymmetric growth
Asymmetric loading

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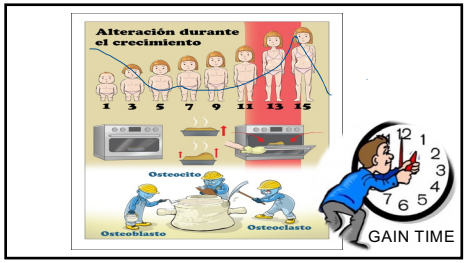
Alteración durante el crecimiento
1 3 5 7 9 11 13 15
Osteocito
Osteoblasto
Osteoclasto
GAIN TIME

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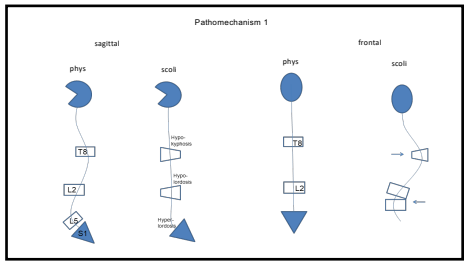
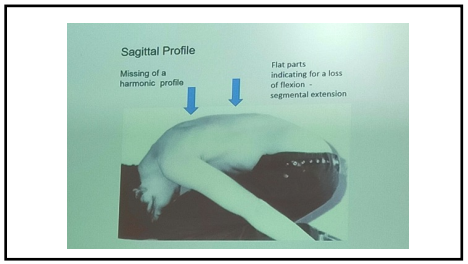

Pathomechanism 1
sagittal
frontal
phys
scoli
phys
scoli
T8
L2
L5
S1
T8
L2

15


Sagittal Profile
Missing of a harmonic profile
Flat parts indicating for a loss of flexion - segmental extension

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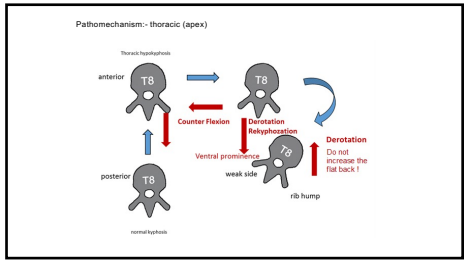

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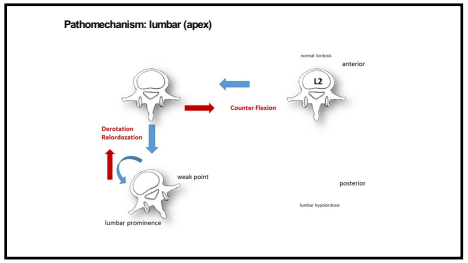

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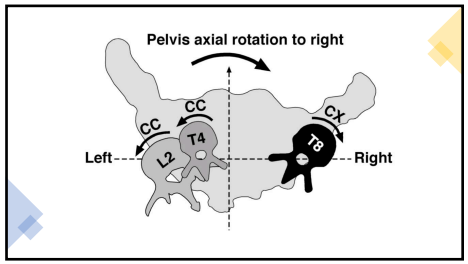

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Red flags

Congenital Scoliosis	Other malformation
Neurological scoliosis	Neuro muscular (nerve, muscle…) Neuro central (cerebral palsy, siringomyelia…) - OTR Absence or diminution - OTR Exacerbation - Hipo tonia - Hiper tonia - Rigid spine - ACR absents - Joint stiffness - Joint stiffness
Fridriech ataxia	- Dismetria at finger-nose test, heel-knee test - Ataxic walking
Medular lesion (syringomyela or occipito-cervical malformacion)	- Left toracic curve - Asimetris of ACR
Tumoral	- angular scoliosis - Reactives curves - Alteracion of general state
Marfan syndrome	- Arachnodactyly - Joint hyperlaxity - Cutaneous hyperlaxity - Pectus excavatum
Neurofibromatosis type 1 or Recklinghausen	- Cafés au lait" macules, Cutaneous neurofibromas - Pectus excavatum - Heart murmur

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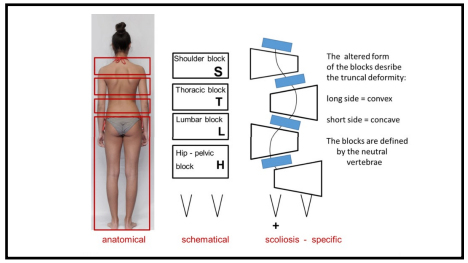
Shoulder block
S
Thoracic block
T
Lumbar block
L
Hip - pelvic block
H
The altered form of the blocks describe the truncal deformity:
long side = convex
short side = concave
The blocks are defined by the neutral vertebrae
anatomical
schematical
scoliosis - specific

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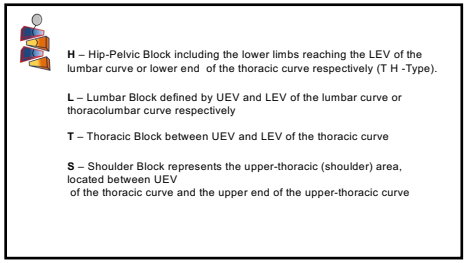
H – Hip-Pelvic Block including the lower limbs reaching the LEV of the lumbar curve or lower end of the thoracic curve respectively (T H -Type).
L – Lumbar Block defined by UEV and LEV of the lumbar curve or thoracolumbar curve respectively
T – Thoracic Block between UEV and LEV of the thoracic curve
S – Shoulder Block represents the upper-thoracic (shoulder) area, located between UEV of the thoracic curve and the upper end of the upper-thoracic curve

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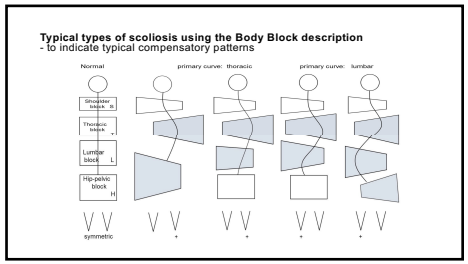
Typical types of scoliosis using the Body Block description
- to indicate typical compensatory patterns
Normal
primary curve: thoracic
primary curve: lumbar
Shoulder block S
Thoracic block T
Lumbar block L
Hip-pelvic block H
symmetric

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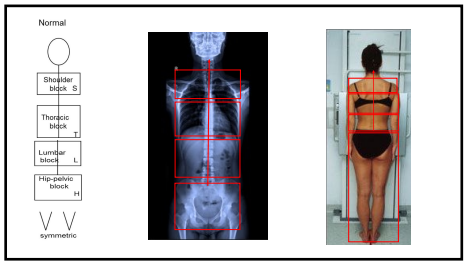
Normal
Shoulder block S
Thoracic block T
Lumbar block L
Hip-pelvic block H
symmetric

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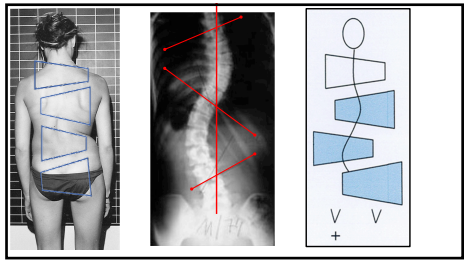
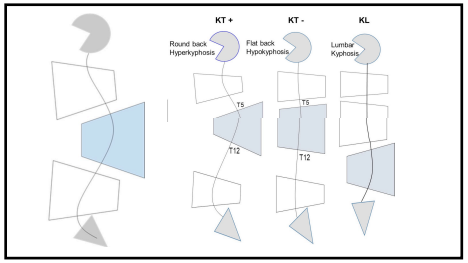

V V
+

25


KT +
KT -
KL
Round back
Hyperkyphosis
Flat back
Hypokyphosis
Lumbar
Kyphosis
T5
T12
T5
T12

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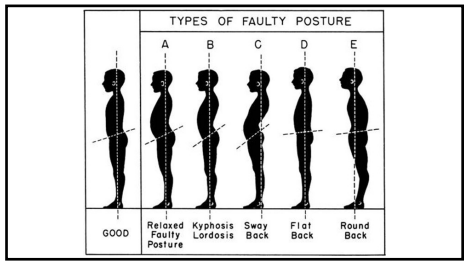
TYPES OF FAULTY POSTURE
A
B
C
D
E
GOOD
Relaxed Faulty Posture
Kyphosis Lordosis
Sway Back
Flat Back
Round Back

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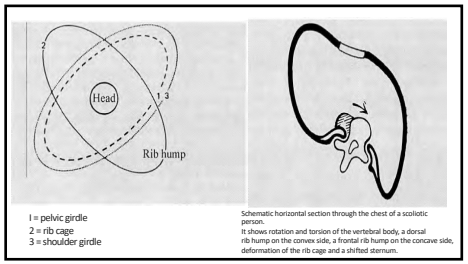
Head
Rib hump
1 = pelvic girdle
2 = rib cage
3 = shoulder girdle
Schematic horizontal section through the chest of a scoliotic person.
It shows rotation and torsion of the vertebral body, a dorsal rib hump on the convex side, a frontal rib hump on the concave side, deformation of the rib cage and a shifted sternum.

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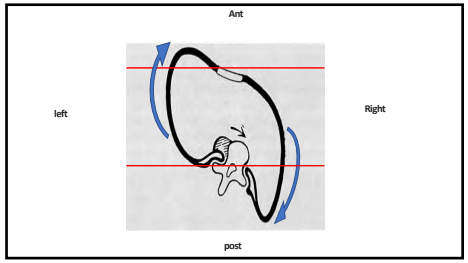

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(A) Overhead view of a girl with a right thoracic idiopathic scoliosis

B) Overhead view with a lumbar lordosis obliterated, producing thoracic hyperextension and returning the lordosis closer to the midline.

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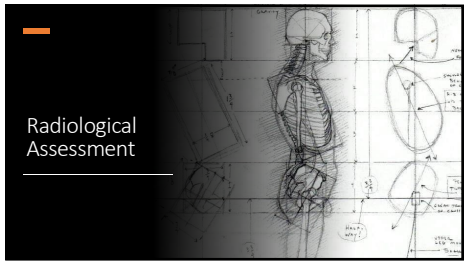

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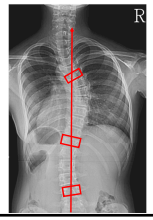
General Terms for Radiological Assessment

- **Neutral Vertebra:-**

This vertebra refers to the junction zone of the buckled spine.

It is located at the lower end of a curve (**LEV**) and the upper end (**UEV**) of the next curve or vice versa.

The radiological characteristics of this vertebra exhibit
the least rotation,
the least structural deformities,
the least side deviation,
and it is the **most tilted vertebra** in comparison to the adjoining vertebrae within the junction zone.



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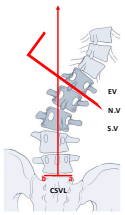
End, Neutral, and Stable Vertebrae



The ***end*** vertebrae (EV)
are the most tilted vertebrae at the cephalad and caudal ends of a curve.

neutral vertebra (NV)
is the most cephalad vertebra below the apex of the major curve whose pedicles are symmetrically located within the radiographic silhouette of the vertebral body.

the ***stable*** vertebra (SV).
The most cephalad vertebra immediately below the end vertebra of the major curve that is most closely bisected by the CSVL.

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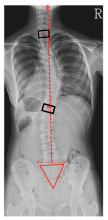
Central sacral line (C.S.L – C.S.V.L)

The Central sacral line (central sacral vertical line) is a vertical line erected from the midpoint of the sacrum or the spinous process of S1.

- CSL helps to assess **frontal trunk deviation.**
- Important references are the **TP** and **T1.**
- In the Lenke classification the **lumbar apical vertebra** is also used to define the **severity of the lumbar curve.**



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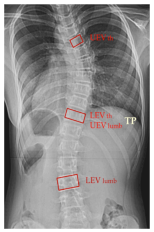
- **TP**

- The Transitional point is a theoretical point (turning point) in the junction between thoracic and the lumbar curve.

mostly assessed in the middle of the neutral vertebra (LEV thoracic or UEV lumbar).



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- **CSL – TP** (COG centre of gravity - weight-bearing – body statics)

- This is used for radiological assessment of body statics (COG-Centre of Gravity).
- The relation between TP and CSL determines the major curve and the typical weight distribution seen in body.
- statics. For the upper trunk T1 in relation to the CSL indicates the deviation in statics.

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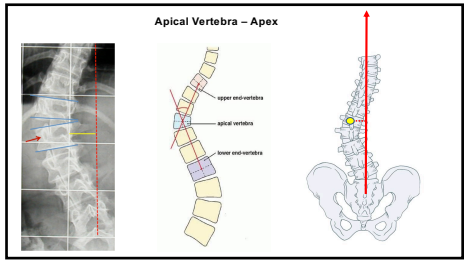

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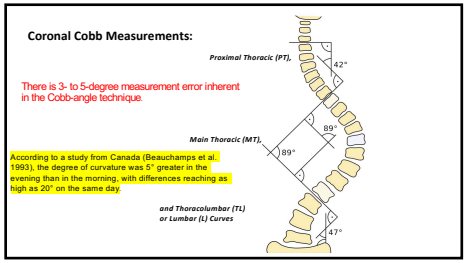

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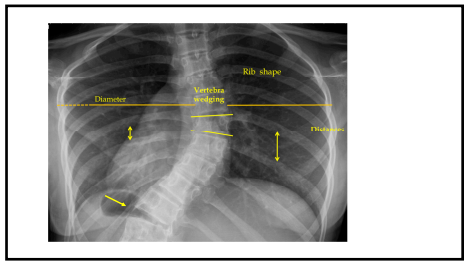

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1. Neutral vertebrae
2. Apical vertebrae
3. cobb's angle
4. Major curve
5. S.C.V.L
6. Weight bearing
7. Compensated or decompensated curvatures
8. Transition point

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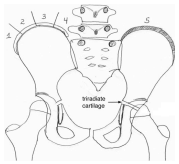
Indicators for osseous maturation



Risser Sign

Risser 0 – No iliac apophysis visible

Risser 1 – Initial appearance of ossification of the iliac apophysis

Risser 2 – Migration halfway across the top of the iliac wing

Risser 3 – Three-fourths of the distance

Risser 4 – Ossification crossing the iliac wing, but not fused to the ilium

Risser 5 – Complete ossification of the iliac apophysis with fusion to the ilium

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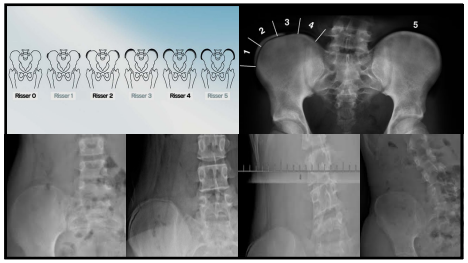

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Definition of progression:-

Relative progression: Increase of >5° Cobb between successive x-ray films, within one year.

Absolute progression: Increase of >5° for a longer period.

5° is assessed as the (manual) measurement error. Problem is the definition of the end vertebrae. The measurement error in digital systems is slightly lower. (Langensiepen)

important factors for scoliosis progression in children

1. Curve pattern

2. A g e (chronological)

3. Maturity indicators

4. C o b b a n g l e / r o t a t i o n

5. S a g i t t a l s p i n a l p r o f i l e

6.0Calculation of the risk of progression
Lonstein & Carlson scale 1984

7. Growth Spurt / G e n d e r

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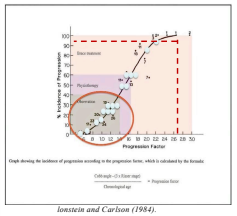

lonstein and Carlson (1984).

E.g.

1. Girl 11J 25°Cobb Risser 0. 25-3x0.11=2.27
The estimated risk of progression is **VERY.**

Risk of progression:

Low risk = 5 to 15 percent;
moderate risk = 15 to 40 percent;
High risk = 40 to 70 percent;
very high risk = 70 to 90 percent.

- *Indication for observation only (Incidence (risk) of progression 40%)*
- *Indication for physiotherapy (Incidence (risk) of progression 40-60%)*
- *Indication for bracing (Incidence (risk) of progression 60% and more)*
- *patient from the majority of papers on physical therapy found have no indication for treatment, but only for observation*

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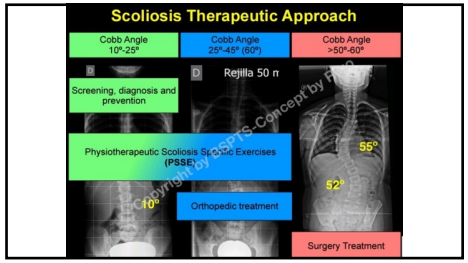
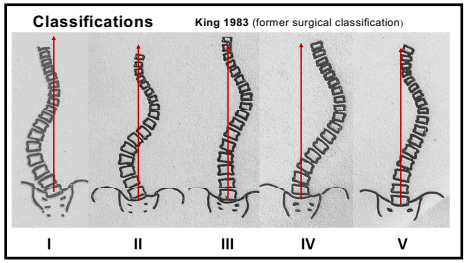
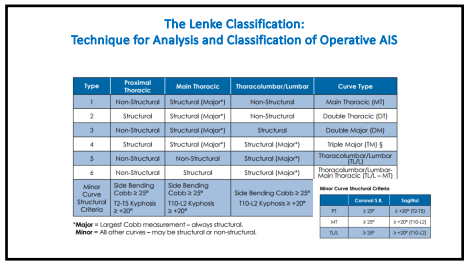

Scoliosis Therapeutic Approach
Cobb Angle 10°-25°
Cobb Angle 25°-45° (60°)
Cobb Angle >50°-60°
Screening, diagnosis and prevention
Rejilla 50 π
Physiotherapeutic Scoliosis Specific Exercises (PSSE)
Orthopedic treatment
Surgery Treatment
55°
52°
10°

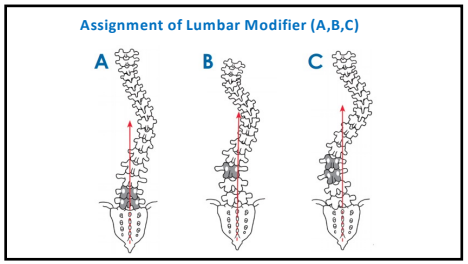
45


Classifications
King 1983 (former surgical classification)
I
II
III
IV
V

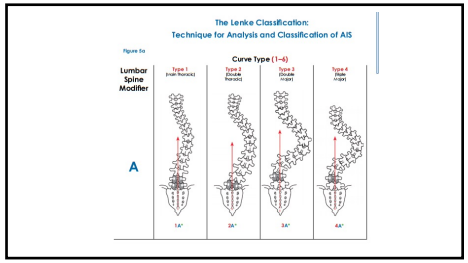
46


The Lenke Classification:
Technique for Analysis and Classification of Operative AIS
Type
Proximal Thoracic
Main Thoracic
Thoracolumbar/Lumbar
Curve Type
Minor Curve Structural Criteria
Minor Curve Structural Criteria
Sagittal

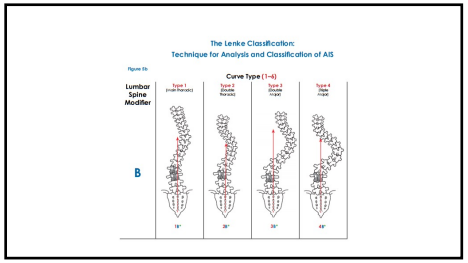
47


Assignment of Lumbar Modifier (A,B,C)
A
B
C

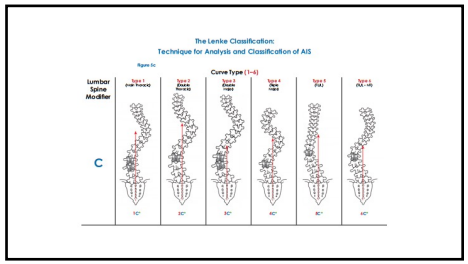
48


The Lenke Classification:
Technique for Analysis and Classification of AIS
Figure 5a
Curve Type (1–6)
Lumbar Spine Modifier
A

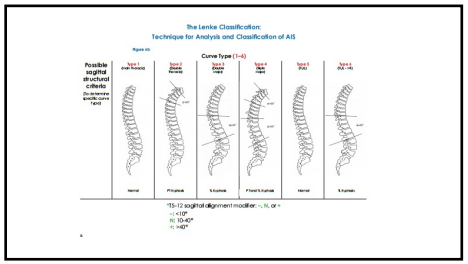
49


The Lenke Classification:
Technique for Analysis and Classification of AIS
Figure 5b
Curve Type (1–6)
Lumbar Spine Modifier
B

50


The Lenke Classification:
Technique for Analysis and Classification of AIS
Figure 5c
Curve Type (1–6)
Lumbar Spine Modifier
C

51


The Lenke Classification:
Technique for Analysis and Classification of AIS
Figure 6b
Curve Type (1–6)
Possible sagittal structural criteria
Normal
Hyperkyphosis
Hyperkyphosis
Hyperkyphosis
Normal
Hyperkyphosis
*T5-12 sagittal alignment modifier: -, N, or +
-: <10°
N: 10-40°
+: >40°

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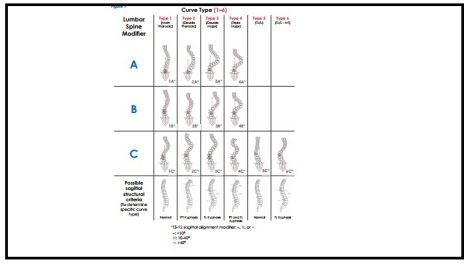

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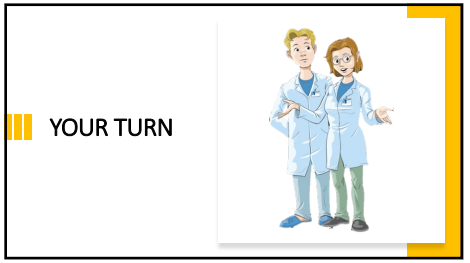
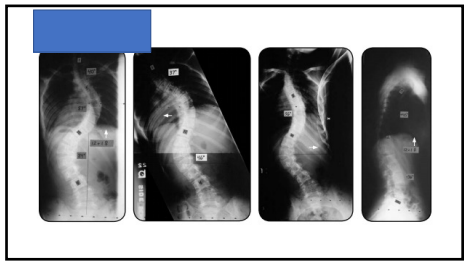


54



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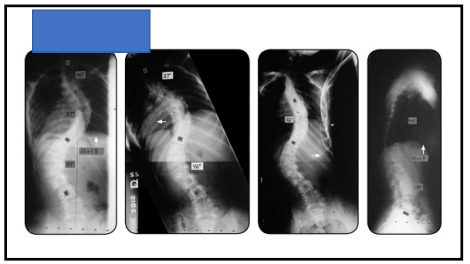
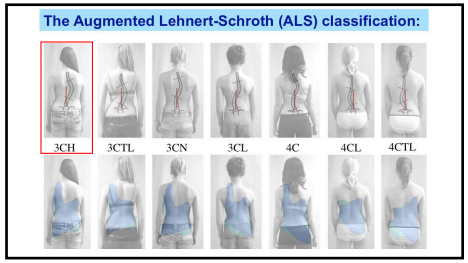
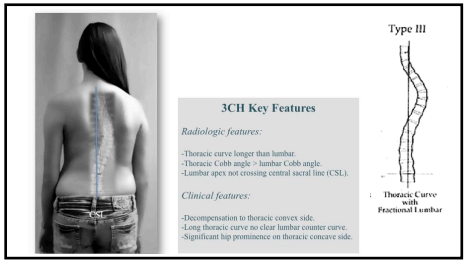


56


The Augmented Lehnert-Schroth (ALS) classification:
3CH
3CTL
3CN
3CL
4C
4CL
4CTL

57


3CH Key Features
Radiologic features:
-Thoracic curve longer than lumbar.
-Thoracic Cobb angle > lumbar Cobb angle.
-Lumbar apex not crossing central sacral line (CSL).
Clinical features:
-Decompensation to thoracic convex side.
-Long thoracic curve no clear lumbar counter curve.
-Significant hip prominence on thoracic concave side.
Type III
Thoracic Curve with Fractional Lumbar

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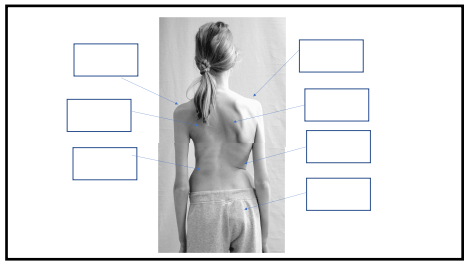
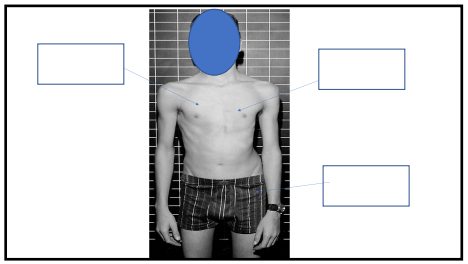


59



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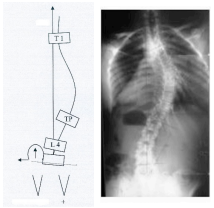
Radiological characteristics

- Major curve is ……..
- Thoracolumbar transition and T1 shifted toward ……..
- L4 tilted toward ……..
- The Iliac crest is higher on the …..side



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Treatment Guidelines

For skeletally immature patients Risser 0-3, treat as follows

Cobb	SRS Guidelines	SOSORT Guidelines
15 - 20 Deg	*"WAIT & SEE"* Observe	***"TREAT AND SEE"*** Educate + consider early bracing and PSSE in select cases
25-45 Deg	Brace	Brace + Educate + PSSE
45 - 50 Deg	Surgery	Brace + Educate + PSSE Surgery as option based on patient choice/function
ADULT	**n/a or surgery**	**PSSE + PT + optional bracing prior to surgical decision**

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Table 4 Goals of treatment according to the SOSORT Consensus paper [42].

Rank	Aim	Percentage of responders
1	Esthetics	100%
2	Quality of life	91%
3	Disability	91%
4	Back Pain	87%
5	Psychological well-being	84%
6	Progression in adulthood	84%
7	Breathing function	84%
8	Scoliosis Cobb degrees	84%
9	Need of further treatments in adulthood	81%

Only the goals that reached 80% of agreement are listed here, starting from the most important. The column "Percentage of responders" refers to those that considered each outcome relevant during the Consensus Conference.

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Scoliosis Treatment: General Principle

Reaching the best possible frontal and sagittal plane alignment throughout Detorsional Forces"

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